

Thomas E. Murphy

Exobiology Branch
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EDUCATION

- PhD UNIVERSITY OF TEXAS AT AUSTIN** August 2013
Doctor of Philosophy in Mechanical Engineering.
Dissertation: “Artificial Leaf for Biofuel Production and Harvesting: Transport Phenomena and Energy Conversion”
PhD. Dissertation Advisor: Dr. Halil Berberoglu
- MS UNIVERSITY OF TEXAS AT AUSTIN** May 2011
Master of Science in Mechanical Engineering.
M.S. Thesis: “Radiant and Thermal Energy Transport in Planktonic and Benthic Algae Systems for Sustainable Biofuel Production”
- BS BROWN UNIVERSITY, PROVIDENCE, RI** May 2009
Bachelor of Science in Mechanical Engineering with Honors.
Honors Thesis: “Design of a Handheld Microfluidics Disease Diagnostic Device”

AWARDS and SCHOLARSHIPS

- Best poster award, 7th Annual Algae Biomass Summit, 2013
- William Hogg Endowed Fellow, University of Texas at Austin, 2012-13.
- NASA Texas Space Grant Consortium Fellow, 2011-12.
- National Science Foundation Graduate Research Fellowship Program Honorable Mention, 2011.
- Harvey D. Attra Endowed Fellowship for Outstanding Academic Record, 2009-13
- Domenico A. Ionata Fund Recipient for Creativity and Imagination in a Senior Research Project, 2009

RESEARCH EXPERIENCE

NASA AMES RESEARCH CENTER, EXOBIOLGY BRANCH – MOFFETT FIELD, CA

Post-doctoral Research Fellow, *principal investigator Dr. Leslie Bebout* April 2014 – present

- Modeled transport of electromagnetic radiation in densely packed photosynthetic communities for remote detection applications
- Developed novel radiance probe for measuring directionality of light fields within scattering media
- Developed method for measuring depth dependent photosynthetic rate in open ponds for algae cultivation
- Designed a method for tuning locally available light spectra in algal cultures for enhanced productivity

UNIVERSITY OF TEXAS AT AUSTIN, SOLAR ENERGY AND RENEWABLE FUELS LAB – AUSTIN, TX

Post-doctoral Research Fellow, *principal investigator Prof. Halil Berberoglu* September 2013 – December 2013

- Developed synthetic leaf for secreted product harvesting for ultra-efficient algal bioproduct generation
- Designed a device and method for multispectral imaging of algal cultures for real time culture diagnostics

NASA AMES RESEARCH CENTER, EXOBIOLGY BRANCH – MOFFETT FIELD, CA

Visiting Graduate Researcher, *supervising civil servant Dr. Leslie Bebout* July-August 2012, August 2013

- Designed, constructed, operated, and characterized novel “synthetic leaf” photobioreactor for closed-loop life support of humans in space
- Developed a novel scoring parameter for evaluating the efficiency of light sources for illuminating algae for maximum photosynthetic rate

UNIVERSITY OF TEXAS AT AUSTIN, SOLAR ENERGY AND BIOFUELS LAB – AUSTIN, TX

Graduate Research Assistant, *advisor Prof. Halil Berberoglu* January 2010 – August 2013

- Modeled fluid flow in a synthetic leaf photobioreactor taking into account gravitational, capillary, and viscous forces
- Constructed a two dimensional combined light and mass transport numerical finite element model for matching photon flux with nutrient flux for optimizing photosynthetic biofilm productivity
- Constructed a three dimensional Monte Carlo code for modeling light transport in a nanoparticle-loaded window for photovoltaic energy harvesting
- Developed a novel image processing technique to monitor the productivity of algae cultures using a commercial digital camera
- Designed and constructed a custom experimental setup for measuring the photosynthetic rate of algae using oxygen evolution techniques as well as pulse-amplitude modulated (PAM) fluorometry
- Modeled light transport and growth in planktonic photobioreactors using the radiative transport equation (RTE) and a numerical inverse method
- Created a two dimensional numerical thermal model for calculating the transient temperature and evaporative water loss rate from biofilm photobioreactors
- Oversaw laboratory operations, including purchasing, algae culture room maintenance, and inventory management
- Supervised two undergraduate students in projects pertaining to algae biofuel research

BROWN UNIVERSITY, MICROFLUIDICS LAB – PROVIDENCE, RI

Undergraduate Research Assistant, *advisor Prof. Anubhav Tripathi* January 2008 – August 2009

- Designed a handheld microfluidics device for real-time influenza virus RNA detection
- Modeled heat transfer in microfluidics systems with COMSOL multiphysics
- Designed and implemented custom pressure manifold for use in microfluidics experiments

REFEREED ARTICLES IN ARCHIVAL JOURNALS

1. Murphy T.E., Kapili B.K., Detweiler A.M., Bebout B.M., and Prufert-Bebout L.E., 2015. Vertical distribution of algal productivity in open pond raceways. *Algal Research* (in review).
2. Murphy T. E., Pilorz S., Prufert-Bebout L. and Bebout B., 2015. *A novel microsensor for measuring angular distribution of radiative intensity*. Photochemistry and Photobiology (in press). doi: 10.1111/php.12452
3. Murphy T.E., Fleming E., and Berberoglu H., 2014. *Vascular structure design of an artificial tree for microbial cell cultivation and biofuel production*, Transport in Porous Media, vol. 104, no. 1, pp. 25-41.
4. Nasouri B., Murphy T.E., Berberoglu H., 2014. *Simulation of laser propagation through a three-layer human skin model in the spectral range from 1000 to 1900 nm*. Journal of Biomedical Optics, vol. 19, no. 7, 75003.
5. Murphy T.E. and Berberoglu H., 2014. *Flux balancing of light and nutrients in a biofilm photobioreactor for maximizing photosynthetic productivity*, Biotechnology Progress, vol. 30, no. 2, pp. 348-359.
6. Murphy T.E., Macon K. and Berberoglu H., 2013. *Rapid algal culture diagnostics for open ponds using multispectral image analysis*, Biotechnology Progress, vol. 30, no. 1, pp. 233-240.
7. Murphy T.E., Macon K. and Berberoglu H., 2013. *Multispectral image analysis for algal biomass quantification*, Biotechnology Progress, vol. 29, no. 3, pp. 808-816.
8. Crawford R., Murphy T.E., Berberoglu H., and da Silva A., 2013. *Experimental characterization of the effects of geometric parameters on evaporative pumping*. Experimental Thermal and Fluid Science, vol. 51, pp. 183-188.
9. Crawford R., Murphy T.E., Berberoglu H., and da Silva A., 2013. *Pumpless evaporative cooling of actively heated surfaces*, Energy and Buildings, vol. 62, pp. 217-221.
10. Murphy T.E. and Berberoglu H., 2012. *Temperature Fluctuation and Evaporative Loss Rate in an Algae Biofilm Photobioreactor*, Journal of Solar Energy Engineering, vol. 134, pp. 011002-1-9.
11. Murphy T.E. and Berberoglu H., 2011. *Effect of algae pigmentation on photobioreactor productivity and scale-up: A light transfer perspective*, Journal of Quantitative Spectroscopy and Radiative Transfer, vol. 112, no. 18, pp. 2826-34.

REFEREED CONFERENCE PROCEEDINGS

1. Nasouri B., Murphy T.E., and Berberoglu H., 2014, *Near infrared laser penetration and absorption in human skin*, SPIE Photonics West, Feb 1-6 (in review).
2. Taylan O., Murphy T.E., and Berberoglu H., 2013, *Light transport analysis of smart windows for solar energy harvesting*, 7th International Symposium on Radiative Transfer, Kusadasi, Turkey, June 2-8, RAD-13-SO3.
3. Murphy T.E., Fleming E., Bebout L., Bebout B., and Berberoglu H., 2012, *A novel microbial cell cultivation platform for space applications*, 1st Annual International Space Station (ISS) Research and Development Conference, Denver, CO, USA, June 26-28, AAS 12-758.
4. Murphy T.E., Macon K. and Berberoglu H., 2012, *An Image Processing Technique to Recover the Biomass Concentration in Algae Biofilm Photobioreactors*, ASME 2012 Summer Heat Transfer Conference, Puerto Rico, USA, July 8-12, HT2012-58422.
5. Murphy T.E. and Berberoglu H., 2011, *Cellular Photosynthetic Rate of Fully and Partially Pigmented Chlamydomonas reinhardtii as a Function of Irradiance*, ASME 2011 International Mechanical Engineering Congress and Exposition, Denver, CO, November 11-17, IMECE2011-64550.
6. Murphy T.E. and Berberoglu H., 2011, *Transient Analysis of Microorganism Temperature and Evaporative Losses in an Algae Biofilm Photobioreactor*, ASME/JSME 8th Thermal Engineering Joint Conference, Honolulu, Hawaii, March 13-17, AJTEC2011-44347.
7. Murphy T.E. and Berberoglu H., 2010, *Increased Photobioreactor Productivity Using Algae with Low Pigmentation: A Light Transfer Perspective*, ASME 2010 International Mechanical Engineering Congress and Exposition, Vancouver, British Columbia, November 12-18, IMECE2010-39482.

TECHNICAL PRESENTATIONS

1. Murphy T.E. and Prufert-Bebout L.E. Synthetic trees for water and energy efficient biological CO₂ conversion. NASA Workshop on CO₂-Based Manufacturing, Moffett Field, CA, USA, June 28-29, 2014.
2. Murphy T.E., Fleming E., and Berberoglu H. Design tool for evaporative pumps. ASME International Mechanical Engineering Congress and Exposition, Montreal, QC, CA, November 14-20, IMECE2014-38699.
3. Murphy T.E., Macon K., and Berberoglu H. A novel multispectral imaging method for real-time algal culture monitoring. 7th Annual Algae Biomass Summit, Orlando, FL, USA, Sept 30 – Oct 3, 2013.
4. Murphy T.E. and Berberoglu H. Attached growth systems for energy and water efficient cultivation of algal biofuels (poster). 7th Annual Algae Biomass Summit, Orlando, FL, USA, Sept 30 – Oct 3, 2013.
5. Murphy T.E., Macon K., and Berberoglu H. A novel multispectral image analysis technique for monitoring the productivity of open pond algae cultivation systems. ASME 2013 Summer Heat Transfer Conference, Minneapolis, MN, USA, July 17, 2013.
6. Murphy T.E. and Berberoglu H. Photon and nutrient flux balancing in a synthetic leaf for maximizing photosynthetic productivity. ASME 2013 Summer Heat Transfer Conference, Minneapolis, MN, USA, July 18, 2013.
7. Berberoglu H., Murphy T.E., and Kulkarni A. Natural versus Artificial Light Usage in Algal Cultivation. 6th Annual Algae Biomass Summit, Denver, CO, USA, September 24-27, 2012.
8. Murphy T.E., Fleming E., Prufert-Bebout L., Bebout B., and Berberoglu H. Algae bioproduct harvesting using synthetic trees: The Surface-Adhering Bioreactor (SABR) (poster). Algae Biomass Summit, Denver, CO, USA, September 24-27, 2012.

INVITED PRESENTATIONS

1. Environmental Engineering Seminar Series, Stanford University, Stanford CA. “Synthetic Trees for Ultra-Efficient Algae Cultivation,” April 3, 2015.

PATENTS

1. Murphy T.E. and Berberoglu H., 2013. Methods and Systems for Diagnostics. International Patent Application No. PCT/US15/14609. Filed February 5, 2015.
2. Berberoglu H., Murphy T.E., Bebout L., and Fleming E. 2013. Capillary driven micro-organism cultivation platform for human life support. Serial number 13/929,646. Application filed June 27, 2013.

RESEARCH CONTRACTS AND GRANTS

1. NASA Ames Center Innovation Fund (CIF) 2015. Fluorescent microbeads for tuning the local light availability in high density algae photobioreactors. \$50,000.

MASTERS THESIS COMMITTEES

1. Daniel Campbell. "Coupling algae biofilm cultivation with wastewater treatment for sustainable biomass production and nutrient recycling." The University of Texas at Austin. Supervisor: Halil Berberoglu, Spring 2015.

TEACHING EXPERIENCE

THE UNIVERSITY OF TEXAS AT AUSTIN, MECHANICAL ENGINEERING DEPARTMENT

Teaching Assistant, Fluid Mechanics Laboratory (ME 130L), January-May 2011

- Conducted laboratory sessions for fluid mechanics experiments for juniors in Mechanical Engineering
- Provided feedback on students' technical writing

Teaching Assistant, Heat Transfer (ME 339), January-May 2010

- Organized and led lectures and review sessions for classes of up to 70 students
- Aided in writing midterm and final examinations

Teaching Assistant, Experimental Heat Transfer (ME 139L), August-December 2009

- Conducted laboratory sessions for heat transfer experiments for juniors in Mechanical Engineering
- Advised the instructor on improving the course in future semesters

REVIEWER OF MANUSCRIPTS FOR JOURNALS AND CONFERENCES

REVIEWER FOR THE FOLLOWING JOURNALS:

- Biotechnology Progress
- Astrobiology
- 3D Printing and Additive Manufacturing

REVIEWER FOR THE FOLLOWING CONFERENCES:

- ASME, International Mechanical Engineering Congress and Exposition (IMECE)
- ASME, Summer Heat Transfer Conference

MEMBER OF PROFESSIONAL SOCIETIES

ALGAE BIOMASS ORGANIZATION, 2012-2014

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME), 2010-2012

OUTREACH ACTIVITIES

STUDENT ENGINEERS EDUCATING KIDS (SEEK), UNIVERSITY OF TEXAS AT AUSTIN, 2011

- Engaged middle school students in fun, engaging science experiments

CROCKETT HIGH SCHOOL OUTREACH RESEARCH PROJECTS, UNIVERSITY OF TEXAS AT AUSTIN, 2011-12

- Mentored a high school senior to complete an image analysis project for algae biomass quantification

ENGINEERING OUTREACH PROGRAM, BROWN UNIVERSITY, 2008

- Guided middle school students in a science club to build a solar-powered miniature car at a middle school in an underprivileged neighborhood in Providence, RI

COMPUTER SKILLS

- Languages: Python, FORTRAN 77/90
- Mathematical/Controls software: Matlab, Mathematica
- Design/Analysis software: Pro Engineer, Solidworks, COMSOL, Abaqus
- Presentation software: LaTeX, Microsoft Office

GRADUATE COURSEWORK

Radiation Heat Transfer
Rad. HT in Participating Media
Convective Heat Transfer
Heat and Mass Transfer

Fluid Mechanics
Thermodynamics
Mathematical Methods in Nuclear Eng.
Multiscale Transport

Water Pollution Chemistry
Energy Technology and Policy
Microbiology
Fire Science

LANGUAGE SKILLS

ENGLISH native
SPANISH intermediate

REFERENCES

PROF. HALIL BERBEROGLU

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